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Fishmeal is a highly concentrated nutritious feed ingredient produced by processing of low value fishes and trash fish which are either not suitable for human consumption or has limited consumer preference. It is mainly used as ingredient for preparation of aqua feeds, poultry feeds or animal feeds. The growing demand for aquafeed production and increased landings of low value fishes promoted the establishment of a number of fishmeal plants in the country. Oil sardines, stomatopods, silver bellies and other trash fishes are usually preferred for preparing fishmeal. The trash fishes once discarded by the trawlers are now brought to shore as they realize an economic value owing to the demand from fishmeal plants.

The fishmeal plants convert the trash fish and other low value fishes and fish wastes to fishmeal. Byproducts like fish oil or fish manure are also produced by the fishmeal plants. In India, fishmeal plants are operating in the states of Karnataka, Kerala, Maharashtra, Gujarat and Tamil Nadu. The state of Karnataka has the maximum number of fishmeal plants mainly located in Mangalore and Uttarkannada regions. The present study deals with the economic analysis of fishmeal plants operating in Uttarkannada district of Karnataka. The annual net profit, benefit cost ratio and return on investment were worked out.

There are two fishmeal plants in Uttarkannada district, the Annapoorna bioproteins located at Baithkol and Anfal feed plant at Amdali. These plants

operate for a period of nearly nine months depending on the availability of raw material in the region. Both units produce fishmeal and oil which are used as ingredients of aqua feeds. These units have processing capacity ranging from 100-400 tonnes of fish per day. Oil sardines are mainly used for fishmeal as it yields more oil when compared to other fishes. The purchase price of oil sardines varies



Boiling of fish in a fishmeal plant



A drier unit in the fishmeal plant

from ₹4 to ₹10/kg depending on the season and size of the fish. The recovery varies from 18-24% of fishmeal and 14-18% of fish oil. The fish is washed with water and then cooked in boilers. The cooked fish is pressed for separating the solids and fluids. The settled fish oil is separated from the fluids. The solids are dried and ground for making fishmeal. The fishmeal produced is tested in labs for protein and moisture content. The aquafeeds require fishmeal with protein content of at least 60% and moisture content of 8-10% whereas poultry and animal feeds require less protein content (30-40%) only. The fishmeal and oil are sold to aquafeed plants at Chennai.

Table 1. Annual Costs and returns of fishmeal plants (processing 100 tonnes fish/day)

Particulars	Costs/returns per annum (₹ in lakhs)
<b>A. Investment</b>	
Buildings and other structures	100
Machinery including boiler	150
<b>B. Annual Fixed Cost</b>	
Depreciation	8
Interest on fixed capital	25
Costs of management	3
Insurance	2
<b>Total annual fixed cost(AFC)</b>	<b>38</b>
<b>C. Variable cost</b>	
Labour	16 (0.88)
Electricity	12 (0.66)
Water	32 (1.75)
Cost of fish	1600 (87.59)
Lab Testing fees	0.64 (0.04)
Interest on working capital	166 (9.09)
<b>Total Annual Variable cost(AVC)</b>	<b>1827 (100.00)</b>
<b>D. Total cost/ annum(AFC+AVC)</b>	<b>1865</b>
<b>E. Returns</b>	
Returns fishmeal (18 T/day for 200 days)	1440
Fish oil (10T/ day for 200 days)	1040
<b>Gross Revenue</b>	<b>2480</b>
<b>F. Annual net profit</b>	<b>615</b>
<b>G. Benefit cost ratio (BCR)</b>	<b>1.33</b>
<b>H. Return on investment (%)</b>	<b>246</b>

(Figures in parenthesis indicate share in total variable cost in percentage)

The average investment cost for a fishmeal plant with 100 tonnes processing capacity is ₹2.5 crores. The investment cost consists of costs of buildings and machinery like boilers and driers. The boiler used for cooking fish costs up to one crore rupees. The annual fixed cost was ₹ 38 lakhs. The main components of operational costs were costs of raw material (fish), electricity, water charges and labour cost. Nearly 30-50 workers are engaged in each fishmeal plant for undertaking the various operations. The skilled workers were paid a monthly sum of ₹ 6,000/- and daily wages of ₹ 200/day is given for unskilled workers. The annual variable cost was ₹ 18.27 crores for operating 200 days in a year. The cost of fish accounted nearly 87% of the total variable cost. The price received for fishmeal ranged from ₹40-60/ kg and that of fish oil ranged from ₹50-80/kg depending on the quality. The gross revenue earned with a production capacity of 100 tonnes/day was ₹24.8 crores with an annual net profit of ₹6.15 crores. The benefit cost ratio was 1.33 and return on investment was 246%.



Packing of dried fishmeal in polythene bags

Even though the establishment costs are very high, the fishmeal plants proved highly economical with high return on investment. Trash fish and other bycatch which were earlier discarded due to low market potential can be effectively utilized through fishmeal plants. The increase in the landings of these fishes in recent years offers promising scope for conversion to fishmeal. The revenue generated by

fishermen could be enhanced and this also helps in reducing the environmental problems associated with discards. The landings of clupeids consisting of oil sardines, anchovies and other clupeids have reached 1.13 million tonnes in 2012 and these fishes have low consumer preference in many of the states. The presence of omega-3 fatty acids in these fishes

improves the nutritive value of poultry and aqua feeds. Omega-3 capsules prepared from oil sardine and anchovy oil are now used as dietary supplements due to health benefits. The profitability of fishmeal firms can be further improved by development and preparation of value added byproducts like high quality fish oil or omega-3 capsules.